4.2.8.Line of Sight Drift Rate

4.2.8.1.Purpose

The purpose of this test is to measure the rate at which the FLIR line of sight drifts and to assess the effects that the drift rate has upon the utility of the FLIR for maintaining the selected orientation.

4.2.8.2.General

While using the fuselage referenced stabilization mode, the FLIR line of sight may drift from the selected angles. During the geostable mode, the INS may contribute to the total drift; however, the drift inherent in the fuselage referenced mode will still be present.

4.2.8.3.Instrumentation

A tape measure, square, stop watch and data cards are required for this test. A voice tape recorder is optional.

4.2.8.4.Data Required

Record the elapsed time and horizontal and vertical drift distance for both the fuselage referenced and geostable stabilization mode. Measure the distance from the reticle to the crosshair position on the wall at the start of the test. Record qualitative comments concerning the utility of the FLIR for maintaining an operator selected fuselage referenced orientation or stabilization to a geographic point.

4.2.8.5.Procedure

Park the airplane with the nose pointed at a wall and approximately 30 feet away. Use the tape measure and square to draw a line on the wall parallel to the floor and a bisecting line perpendicular to the first. Place the intersection of the lines at any convenient point on the wall, approximately perpendicular to the FLIR reticle. Measure the distance from the FLIR reticle to the intersection of the lines. Time out the FLIR, select NFOV and fuselage referenced mode and place the crosshairs over the intersection of the lines. Start the stop watch and have an assistant mark the point at which the crosshairs are aligned at one minute intervals. Close communications between the operator and assistant will be required. Use the square to measure and record the horizontal and vertical component of the drift. Continue the test for at least 10 minutes. Repeat in the geostable referenced mode.

During mission relatable navigation to the target area and attacks, assess the utility of the FLIR for maintaining the operator selected orientation. Assess the effects that the fuselage referenced drift rate has upon the utility of the FLIR for navigation and scanning for targets of opportunity and the effects that the geostable drift rate has upon the utility of the FLIR for maintaining alignment over the target position during an attack. Pay particular attention to the effects of the required FLIR updates upon operator workload.

4.2.8.6.Data Analysis and Presentation

Convert the linear horizontal and vertical drift distances to angles using the equation below:

$$\begin{gathered} drift_{\Delta h} = \arctan\left(\frac{drift_h}{l}\right) \\ drift_{\Delta v} = \arctan\left(\frac{drift_v}{l}\right) \\ drift_h = \text{measured horizontal drift} \\ drift_v = \text{measured vertical drift} \\ l = \text{distance to initial crosshair position} \\ drift_{\Delta h} = \text{horizontal drift angle} \\ drift_{\Delta v} = \text{vertical drift angle} \end{gathered} \tag{29}$$

Plot the horizontal and vertical angular drift values versus time for each mode. Analyze the plots for trends. Over the short time periods that are operationally significant to FLIR systems, the trend will likely appear linear. The slope of the line will provide the drift rate. The difference in the drift rates between the fuselage and geostable referenced modes will be INS induced. Note that the drift rates may be self canceling. Relate the drift rates to the workload and operator attention required to maintain FLIR orientation.

4.2.8.7.Data Cards

Sample data cards are provided as card 64.

CARD NUMBER ____

LINE OF SIGHT DRIFT RATE (GROUND TEST)

[POSITION NOSE ON TO A WALL AND 30 FEET AWAY. MARK A HORIZONTAL AND A BISECTING VERTICAL LINE ON THE WALL. SELECT THE FUSELAGE REFERENCED MODE AND NFOV, PLACING THE CURSORS ON THE INTERSECTION OF THE LINES. MARK THE CROSSHAIR POINT EACH MINUTE AND MEASURE THE DRIFTS. REPEAT FOR THE GEOSTABLE MODE.]

DISTANCE TO CROSS ON WALL ____

MODE: FUSELAGE REFERENCED

TIME (MIN)	1	2	3	4	5	6	7	8	9	10
HORIZONTAL										
VERTICAL										

NOTE: GEOSTABLE

TIME (MIN)	1	2	3	4	5	6	7	8	9	10
HORIZONTAL										
VERTICAL										

Card 64: FLIR Line of Sight Drift Rate Data Cards

CARD NUMBER ____TIME _____PRIORITY L/M/H

LINE OF SIGHT DRIFT RATE (AIRBORNE TEST)

[DESCEND TO ____ FEET AGL AND SET MACH=__. HEAD INBOUND TO THE __________ TARGET USING THE FLIR IN THE FUSELAGE REFERENCED MODE FOR NAVIGATION AND LOOK FOR TARGETS OF OPPORTUNITY. ACQUIRE THE TARGET AND PLACE THE CROSSHAIRS ON TOP. UPDATE AS REQUIRED DURING A __________ MODE ATTACK. NOTE THE FREQUENCY OF FLIR UPDATES AND THE EFFECTS UPON THE OPERATOR'S WORKLOAD AND ATTENTION. REPEAT AS TIME ALLOWS.]

ATTACK MODE __________

UPDATE FREQUENCY __________

COMMENTS:

Card 64: FLIR Line of Sight Drift Rate Data Cards (Continued)

4.2.9.FLIR Resolution

4.2.9.1.Purpose

The purpose of this test is to qualitatively and quantitatively assess the cutoff spatial frequency, minimum resolvable temperature differential, airspeed versus spatial frequency response and the line of sight jitter of the FLIR.

4.2.9.2.General

The FLIR resolution quantitative test involves a combined ground and airborne procedure that dictates the measurement of four separate performance parameters simultaneously. The parameters include the cutoff spatial frequency, minimum resolvable temperature differential, line of sight jitter and airspeed versus spatial frequency response. This test procedure requires more instrumentation and ground support than any other test of this book. For this reason, a qualitative procedure, using a minimum of assets is also provided. In keeping with the stated goal of testing with a minimum of expense, instrumentation and flight time, the qualitative assessment is performed first. If problems are noted, the entire quantitative test procedure is then performed to support the qualitative assessment with measured parameters.

The ground procedure requires the use of a collimator with a heated bar target. The collimator is a device designed to make a small ground target appear to the FLIR as if it were a larger target at a much greater distance. Figure 17 [Ref. 37: p.4.49a] depicts a typical collimator/bar target combination. The assembly consists first of a temperature controlled block which can be varied in temperature from -20° to +20° centigrade at approximate steps of 0.2° centigrade. The temperature is measured by a radiometer to an accuracy of about 0.05° centigrade. In front of the temperature controlled block is placed a template of equally spaced and equal sized slots and bars. The template is made of aluminum and approximates ambient temperature. The spatial frequency response of the target is varied by placing different sized templates on the collimator. Next is a planer mirror used to fold the IR path onto the parabolic mirror. It is the nature of a parabolic mirror that light emanating from the focal point of the mirror is reflected outward along parallel lines. The template is located at the focal point of the mirror. It is this feature which makes the target appear as if it were at a great distance. The parabolic mirror directs the IR onto the FLIR reticle. The spatial frequency of the target is approximated by the equation below. [Ref. 37: pp. 4.48-4.49].

$$SF_t=\frac{FL_c}{W_{1c}} \tag{30}$$

SF_t=spatial frequency of the target
FL_c=focal length of the collimator (folded path length from target to mirror)
W_{1c}=width of one bar and one space in target template

The airborne quantitative procedure requires the use of a full size target consisting of alternating heated and non-heated panels. Figure 18 [Ref. 37: p. 4.46b] shows a sample ground target. Note that many other targets, using both active and/or passive elements, are available at various facilities.

Rather than changing the shape of the panels, the aircraft is flown towards the target to provide a change in the spatial frequency. The temperature differential of the bars is controlled within a window of from 0.5° to 10° centigrade. The temperature is then measured to about 0.05° centigrade accuracy using a radiometer. For the airborne target, the spatial frequency of the target at a given range from the target becomes: [Ref. 37: pp. 4.46-4.47].

$$SF_t=\frac{R_t}{W_{1c}} \tag{31}$$

R_t=range from the target

The range between the aircraft and the ground bar target can be supplied by one of two methods. Typically, a ground based radar is used to provide space positioning data on the test aircraft. This is then time correlated with observations made within the aircraft to determine range to the target at the times of interest. [Ref. 37: pp. 4.46-4.47]. This method requires extensive range radar instrumentation. An alternative, and less costly option, is available if an air to ground radar is available within the test aircraft capable of tracking the IR target. Range is derived from the radar as FLIR observations are made. The sample test procedure described below uses the range radar derived space positioning data.